

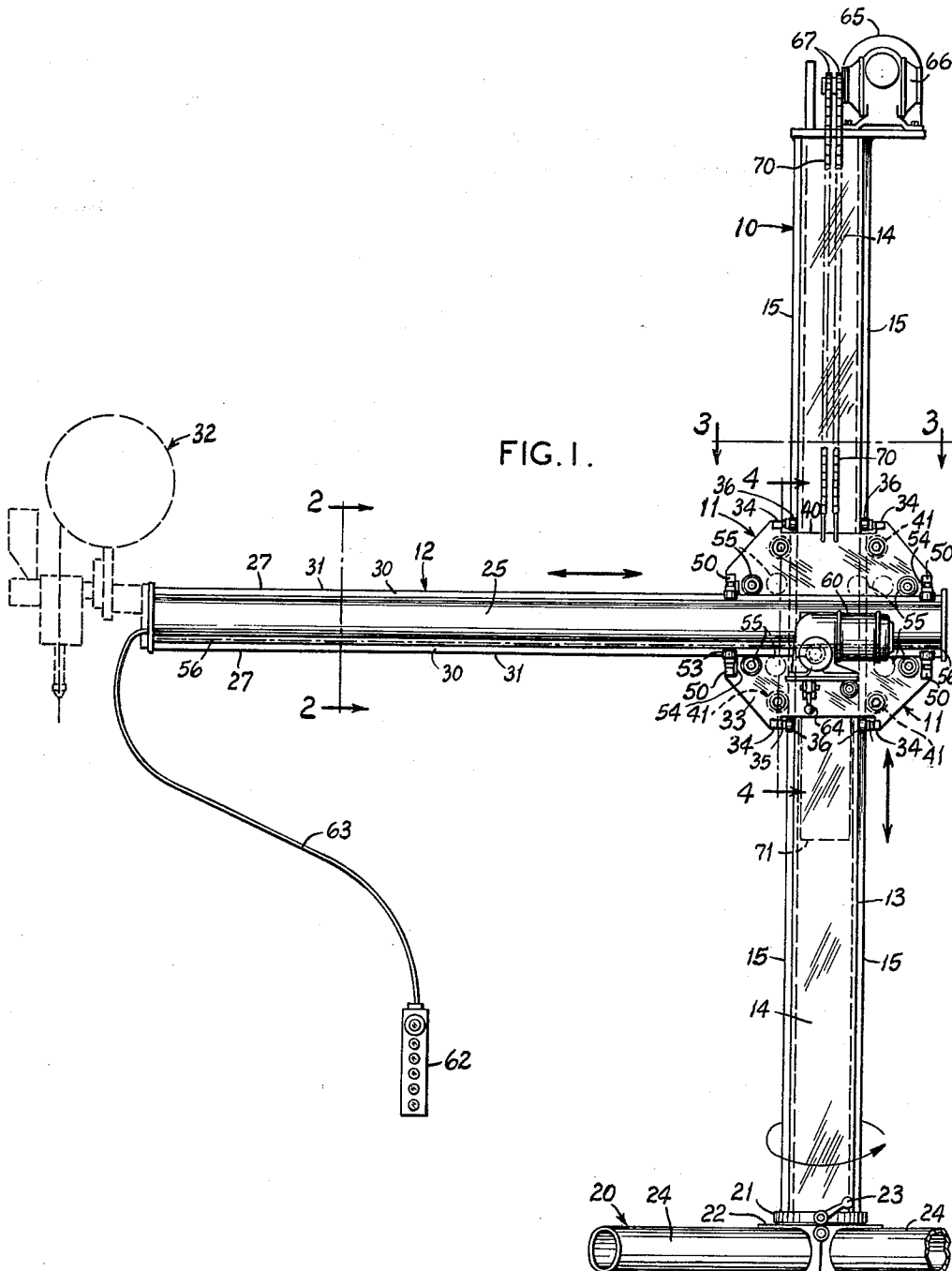
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P. P. WUESTHOFF
MANIPULATOR

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3 Sheets-Sheet 1



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FIG. 3.

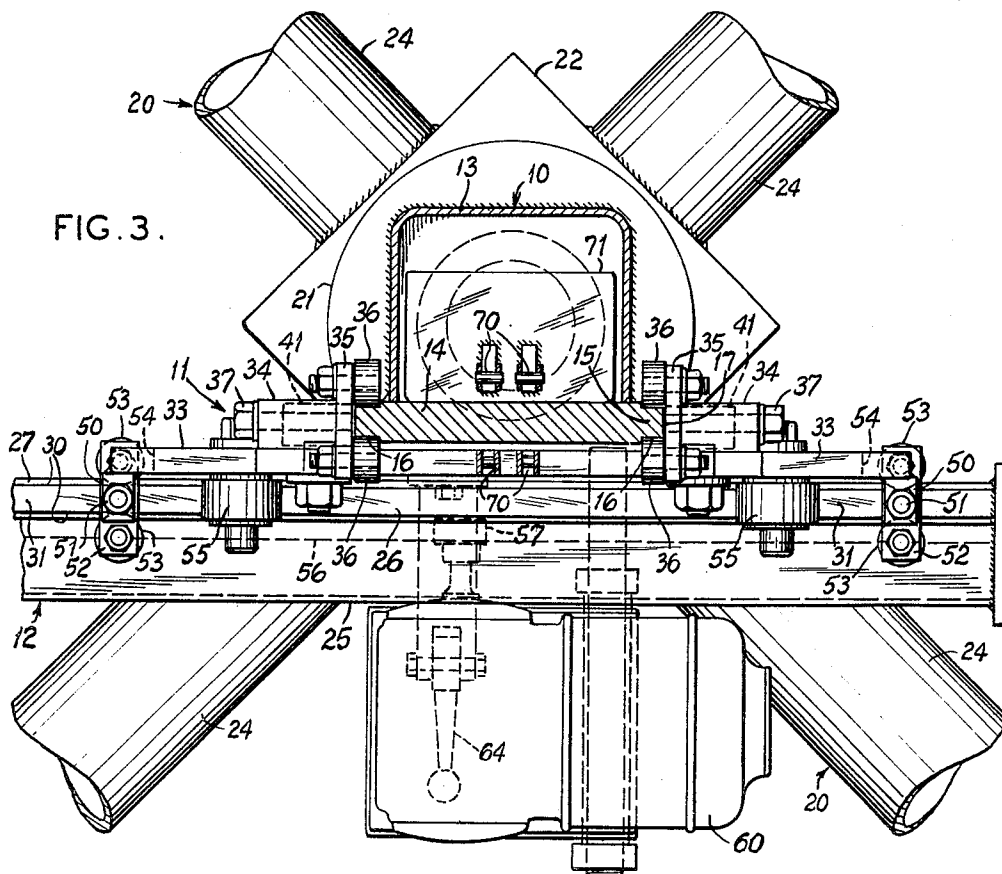
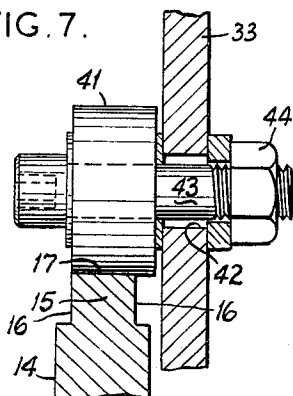


FIG. 7.



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MANIPULATOR

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This invention relates generally to improvements in a manipulator, and more particularly to an improved device of this type utilizing an extensible boom that is mounted to a column by a crosshead.

Heretofore in manipulators of this general type, a tubular column and boom of circular cross section were utilized. The rollers mounted on the interconnecting crosshead engaged longitudinal rails located midway on such tubular column and boom. This particular structural arrangement necessitated the use of a rather thick crosshead structure and inherently caused the plane of boom support on the crosshead to be located at a considerable distance from the plane of support of the crosshead on the column. These units are usually of good size and constructed of heavy material. Because such spacing requirements created a relatively long moment distance, there was a strong possibility of having boom deflection.

It is a major objective of the present invention to construct the column with an elongate vertical flat plate, the boom with an elongate horizontal flat plate, and the crosshead with a flat plate disposed between the column and boom plate in close face-to-face relation. This structural arrangement reduces the distance between the support plane of the boom and crosshead and between the support plane of the crosshead and column to an absolute minimum. The closeness with which the boom plate, crosshead plate and column plate work together reduces any cantilever action, produces great stiffness in the unit construction and eliminates any objectionable deflection of the boom.

Furthermore, in the above described heretofore conventional construction, there was a tendency of the tubular column and boom to collapse as a result of the tremendous pressures exerted on the rails in diametrically opposed regions. The rollers in the present structural arrangement engage opposite side margins of both the column plate and the boom plate. These plates are flat and are constructed to have sufficient solid material to directly oppose and withstand the pressure exerted by the rollers on the side margins. The pressures existing in this type of unit cannot deform or otherwise collapse the column and boom structures in the present invention.

Because of the close juxtaposition of the column plate, boom plate and crosshead plate, the crosshead structure is particularly adapted to provide an efficient mounting for the rollers operatively engaging the margins of the column and boom. An important objective is to provide an adjustable mounting for the rollers so that any wear on the plate margins can be compensated for by repositioning the rollers selectively, yet maintaining the position of the rollers closely adjacent to the plane of the crosshead plate.

Still another important objective is achieved by the provision of a counterweight in the vertical channel of the column, the counterweight being attached to a chain that extends upwardly over a sprocket at the top of the

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column and thence downwardly into attachment with the top of the crosshead plate. The attachment of the chain to the counterweight is offset from the center of gravity of the counterweight so that the counterweight tends to slide reciprocally upon the rear face of the column plate. This structural arrangement provides an economy in the selection of the motor provided to raise and lower the crosshead assembly. Because of the fact that the particular construction of the crosshead, column and boom permits the use of a smaller sprocket driven by the motor, there is less torque required for operation and thereby enables the utilization of a smaller motor size.

Another important object is to provide a manipulator that is simple and durable in construction, economical to manufacture, efficient in operation, and which eliminates or at least minimizes to the greatest extent possible any deflection of the boom.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational view of the manipulator;

FIG. 2 is a side elevational view, partly in cross section, as seen along line 2—2 of FIG. 1;

FIG. 3 is an enlarged cross sectional view as seen along line 3—3 of FIG. 1;

FIG. 4 is an enlarged cross sectional view as seen along line 4—4 of FIG. 1;

FIG. 5 is a fragmentary cross sectional view illustrating one type of mounting for the rollers carried in the crosshead plate;

FIG. 6 is an elevational view of the mounting as seen from the right of FIG. 5;

FIG. 7 is a fragmentary, cross sectional view of another type of adjustable mounting for the rollers carried by the crosshead plate, and

FIG. 8 is a cross sectional view of another type of boom construction that can be used in the manipulator.

Referring now by characters of reference to the drawings, and first to FIG. 1, it is seen that the manipulator consists generally of three elements, namely an elongate vertical column referred to at 10, a crosshead referred to at 11 reciprocally mounted for vertical movement on the column 10, and an elongate horizontally disposed boom referred to at 12 reciprocally carried by the crosshead 11.

The column 10 includes an elongate vertical U-shaped channel 13 that is open along its front side. An elongate vertical plate 14 is attached to the channel 13 and closes the front side of such channel. As is best seen in FIG. 3, the flat plate 14 is relatively thick compared with the thickness of the channel 13, and includes side margins 15 that extend beyond the sides of the channel 13. Each of these side margins 15 is machined to provide a square rail having opposed rail sides 16 and a rail web 17.

The column 10 is supported by a base 20. More particularly, the bottom end 21 of column 10 is swiveled to the base center part 22 which permits the boom 12 to be swung preferably to any desired position within a 360 degrees circle. A locking mechanism 23 operatively interconnects the bottom column end 21 with the center base part 22 to retain the column 10 in a desired position, and thereby retain the boom 12 at a selected position. A plurality of pipes 24 extend from the sides of the center

base part 22 and serve to maintain the column 10 securely in an upright position as illustrated.

The boom 12 is constructed somewhat similarly to the column 10. It includes an elongate horizontal U-shaped channel 25 that is open at its rear side. A relatively thick flat plate is secured to the channel 25 and closes the rear side. The flat plate 26 has top and bottom margins 27 that extend beyond the top and bottom sides of channel 25. As is best seen in FIG. 3, the top and bottom margins 27 are each machined to provide a square rail having opposed rail sides 30 and a rail web 31.

In use, the outer end of boom 12 is utilized to support a welding unit shown in broken lines in FIG. 1 and indicated at 32. The channel 25 of boom 12 provides a suitable rigid structure to which the welding unit 32 may be attached. Moreover, the channel 25 retains and positions certain electrical control mechanism as will be later described.

In FIG. 8, an alternate construction of the boom 12 is shown. In this embodiment, a rigid bar 72 is attached to the boom plate 26 and extends outwardly at a right angle. This bar 72 takes the place of the U-shaped channel 25 in the preferred embodiment. The bar 72 and the boom plate 26 provide sufficient structure at the outer end of the boom 12 to carry the welding unit 32.

The crosshead 11 consists of a flat plate 33 located between the column plate 14 and the boom plate 26. It will be importantly noted that these plates 14—26—33 are located close together in face-to-face relationship as is best seen in FIGS. 3 and 4.

Extending from the rear of crosshead plate 33 are a plurality of rear projections 34. One of these projections 34 is located at each side of the column plate 14 and above and below the boom 12. Pivotally mounted to each of these rear projections 34 is an arm 35. A pair of rollers 36 are rotatively mounted and carried on the end of each arm 35. These rollers 36 engage the opposed rail sides 16 of the column plate margins 15. To compensate for wear either on the rail sides 16 or on the rollers 36, the arm 35 can be pivotally adjusted by loosening and tightening the cap screw 37. Thus it is seen that the arm may be pivotally adjusted to regulate the pressure of the rollers 36 on the rail sides 16.

In order that the crosshead plate 33 be located as close as possible to face-to-face relationship with the column plate 14, the crosshead plate 33 is provided with a plurality of recesses 40 into which one of the rollers 36 of each pair carried by the pivoted arms 35 can interfit. These recesses 40 are proportioned to permit selective adjustment of the pivotal position of arm 35 without interference to either the arm 35 or the roller 36 projecting into the recess 40 and through the crosshead plate 33.

In addition, a plurality of rollers 41 project from the rear of the crosshead plate and engage the rail webs 17 of the column plate side margins 15. One of these rollers 41 is located at each side of the column plate 14 above and below the boom 12.

One of the type of mountings for the rollers 41 is illustrated in FIG. 7. In this embodiment, the crosshead plate 33 is provided with a plurality of apertures 42, one such aperture 42 for each roller 41. Extending through aperture 42 is a stub shaft 43 of smaller diameter than aperture 42. The roller 41 is rotatively mounted on stub shaft 43 closely adjacent to the rear face of crosshead plate 33, the roller 41 being adapted to engage the rail web 17 on the side margin 15 of the column plate 14. A nut 44 threadedly attached to the opposite end of stub shaft 43 clamps the shaft 43 in place and positions roller 41. To regulate the pressure of roller 41 on the rail web 17 or to compensate for wear of roller 41, the nut 44 can be loosened and the position of the stub shaft 43 in the plate aperture 42 can be selectively adjusted and re-located.

Another embodiment of the adjustable mounting for rollers 41 is illustrated in FIGS. 4 and 5. For example,

in FIG. 5, an eccentric bushing 45 is rotatively mounted in the plate aperture 42. The stub shaft 43 on which the roller 41 is rotatively mounted extends through an offset bore 46 formed in the eccentric bushing 45. A nut 47 threadedly attached to the end of stub shaft 43 clamps the shaft 43 in place and locates the position of roller 41. To regulate the pressure of roller 41 on the rail web 17, the nut 47 is loosened and the eccentric bushing 45 is rotated to reposition shaft 43. After adjustment, the nut 47 is retightened.

Extending from the front of crosshead plate 33 are a plurality of front projections 50, one of these projections 50 being located at the top and bottom margins 27 of the boom plate 26 and on opposite sides of the column 10. Pivotally mounted by a cap screw 51 is an arm 52. A pair of rollers 53 are rotatively mounted on the ends of each pivoted arm 52, these rollers engaging the opposed rail sides 30 on the top and bottom margins 27 of the boom plate 26.

To regulate the pressure of rollers 53 on the rail sides 30, the position of the pivoted arm 52 can be adjusted. To enable the boom plate 26 to be located closely adjacent the front face of the crosshead plate 33, the crosshead plate 33 is provided with a plurality of recesses 54 into which one of the rollers 53 and a portion of the arm 52 carrying such roller can interfit.

A plurality of rollers 55 are carried by the crosshead plate 33 and project from the front face of such plate. These rollers 55 can be mounted to crosshead plate 33 in either of the two ways previously described with respect to rollers 41. These rollers 55 are located along the top and bottom margins 27 of the boom plate 26 and on opposite sides of the column 10, and engage the rail webs 31 of the boom plate margins 27.

The number of rollers 55 utilized in this manipulator is selected and determined upon the amount of load carried at the end of boom 12. For example, if such load on boom 12 were sufficient, additional rollers 55 could be added as is illustrated in FIG. 1 by broken lines. Of course, additional rollers 41 could be added to engage the column 10, if needed.

A rack 56 is secured to the front face of boom plate 26 immediately below the channel 25. A drive pinion 57 meshes with the rack 56, the pinion 57 being driven by an electric motor 60 mounted on a table 61 that is attached to the front face of crosshead plate 33. A control box 62 (FIG. 1) is connected by cord 63 to the motor 60, the cord 63 extending through the boom channel 25. Rotation of drive pinion 57 by motor 60 causes either extension or retraction of boom 12 as desired. Furthermore, the drive pinion 57 can be operatively disengaged from the rack 56 upon shifting the position of the motor 60 by the lever 64 (FIG. 4). When disengaged, the boom 12 can be manually moved to any desired position.

Another motor 65 is mounted on the top of column 10 as shown in FIG. 1. The motor 65 operates through a suitable speed reduction unit 66 to drive one or more sprockets 67. A chain 70 is passed over the sprocket 67 that constitutes an upper bearing member. One end of chain 70 is attached to the top of crosshead plate 33, while the other end of chain 70 extends down into the channel 13 of column 10 for attachment to a counterweight 71 located therein. Particularly, the chain 70 is attached to counterweight 71 at one side of its center of gravity in a direction toward the column plate 14, thus tending to urge the counterweight 71 against the rear face of column plate 14. Because this particular structural arrangement enables the use of a smaller sprocket than heretofore utilized in manipulators, less torque is required to raise or lower the crosshead assembly carrying the boom 12. This means that a smaller size motor 65 can be utilized, thus resulting in considerable economy.

It is thought that the operation and functional advantages of the manipulator have become fully apparent from the foregoing detailed description of parts.

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Although the invention has been described by making detailed reference to a single preferred embodiment, such detail is to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. In a manipulator, an elongate flat column plate disposed vertically, said column plate having opposed margins, a flat crosshead plate disposed with one side closely adjacent and in face-to-face relation to said column plate, means carried by said crosshead plate and engaging said side margins of said column plate to mount the crosshead plate for vertical reciprocating movement along said column plate, an elongate flat boom plate disposed horizontally, said boom plate being arranged closely adjacent and in face-to-face relation to the other side of said crosshead plate, the distances between the support planes of said flat plates being reduced to a minimum, said boom plate having opposed top and bottom margins, and means carried by said crosshead plate and engaging said top and bottom margins of said boom plate to mount the boom plate for horizontal reciprocating movement relative to said crosshead plate.

2. In a manipulator, an elongate vertical flat column plate, an elongate horizontal flat boom plate, a flat crosshead plate between said column plate and said boom plate, said flat plates being disposed closely adjacent each other in face-to-face relation so that the distances between their support planes is reduced to a minimum, roller means on said crosshead plate engaging the sides of said column plate for reciprocally mounting the crosshead plate, and roller means on said crosshead plate engaging the top and bottom of said boom plate for reciprocally mounting the boom plate.

3. The combination and arrangement of elements as recited above in claim 2, but further characterized by the provision of a counterweight slidably engaging the rear side of said flat column plate, and means attached to said crosshead plate extending upwardly along the front face of the column plate and extending downwardly along the rear face of the column plate for attachment to the counterweight at one side of its center of gravity so that the counterweight is urged against the rear face of the flat column plate.

4. In a manipulator, an elongate vertical flat column plate having straight opposed side margins squared to provide opposed rail sides and a rail web, an elongate horizontal flat boom plate, said boom plate having straight top and bottom margins squared to provide opposed rail sides and a rail web, a flat crosshead plate between said column plate and said boom plate, said flat plates being disposed closely adjacent each other in face-to-face relation so that the distances between their support planes are reduced to a minimum, rollers carried by said crosshead plate and engaging the rail web and sides of the column plate margins for reciprocally mounting the crosshead plate, and rollers carried by said crosshead plate and engaging the rail web and sides of the boom plate margins for reciprocally mounting the boom plate, the flat column and boom plates directly opposing roller pressure on their rail webs.

5. In a manipulator, an elongate vertical flat column plate, an elongate vertical U-shaped channel secured to said column plate, said column plate having opposed margins extending beyond the sides of said channel, an elongate horizontal flat boom plate, an elongate horizontal U-shaped channel secured to said boom plate, said boom plate having top and bottom margins extending beyond the sides of the last said channel, a flat crosshead plate between said column plate and said boom plate, said flat plates being disposed closely adjacent each other in face-to-face relation so that the distances between their support planes are reduced to a minimum, roller means on said crosshead plate engaging the opposed margins of said column plate for reciprocally

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mounting the crosshead plate, and roller means on said crosshead plate engaging the top and bottom margins of said boom plate for reciprocally mounting the boom plate, a counterweight disposed in the column channel, and an actuating means attached to said crosshead plate, the actuating means extending upwardly along the front face of the column plate and extending into said column channel, said actuating means being attached to said counterweight at one side of its center of gravity so that said counterweight tends to slidably engage the rear face of the column plate for guiding movement.

6. In a manipulator, an elongate flat column plate, an elongate horizontal flat boom plate, a flat crosshead plate between said column plate and said boom plate, said flat plates being disposed closely adjacent each other in face-to-face relation so that the distances between their support planes are reduced to a minimum, said column plate having straight opposed side margins that provide opposed rail sides and a rail web, a plurality of projections extending from the rear of said crosshead plate, said projections being located adjacent the opposed side margins of the column plate and being located above and below said boom plate, rollers pivotally mounted to said projections and engaging the rail sides of said column plate margins, a plurality of rollers carried by said crosshead plate and engaging the rail webs of said column plate margins above and below said boom plate, said flat column plate directly opposing the roller pressure on said rail webs, said boom plate having straight opposed top and bottom margins that provide opposed rail sides and a rail web, a plurality of projections extending from the front of said crosshead plate, said front projections being located adjacent the opposed top and bottom margins of the boom plate and being located on opposite sides of said column plate, rollers pivotally mounted to said front projections and engaging the rail sides of said boom plate margins, and a plurality of rollers carried by said crosshead plate and engaging the rail webs of said boom plate margins at each side of said column plates, said flat boom plate directly opposing the roller pressure on its rail webs.

7. In a manipulator, an elongate flat column plate, an elongate horizontal flat boom plate, a flat crosshead plate between said column plate and said boom plate, said plates being disposed closely adjacent each other in face-to-face relation, the distances between the support planes of said flat column, boom and crosshead plates being reduced to a minimum, said column plate having straight opposed side margins that provide opposed rail sides and a rail web, a plurality of projections extending from the rear of said crosshead plate, said rear projections being located adjacent the opposed side margins of the column plate and being located above and below said boom plate, an arm pivoted to each of said rear projections, rollers mounted to said pivoted arms and engaging the rail sides of said column plate margins, said pivoted arms being selectively movable to adjust the pressure of said rollers on said rail sides, a plurality of rollers engaging the rail webs of said column plate margins above and below said boom plate, said flat column plate directly opposing the roller pressure on said rail webs, means adjustably mounting the last said rollers on said crosshead plate for selectively adjusting the pressure of such rollers against the rail webs, said boom plate having straight opposed top and bottom margins that provide opposed rail sides and a rail web, a plurality of projections extending from the front of said crosshead plate, said front projections being located adjacent the opposed top and bottom margins of the boom plate and being located on opposite sides of said column plate, an arm pivotally mounted to each of said front projections, rollers carried by said arms and engaging the rail sides of said boom plate margins, said arms being pivotally movable to selectively adjust the pressure of the rollers associated therewith against the rail sides, and a

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plurality of rollers engaging the rail webs of said boom plate margins on opposite sides of the column plate, said flat boom plate directly opposing the roller pressure on its rail webs, and means adjustably mounting the last said rollers on said crosshead plate for selectively determining the pressure of said rollers against the rail webs of the boom plate margins.

8. The combination and arrangement of elements as recited above in claim 7, but further characterized by the provision of a counterweight engaging the rear face of the column plate, an actuating means attached to said crosshead plate and attached to said counterweight at one

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side of the center of gravity so that the counterweight slidably engages the rear face of the column plate, and a bearing member over which the actuating means extends, the distance between the support planes of the counterweight and crosshead being reduced to a minimum.

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